Volume Contents

UPDATE ON PLANT-PLANT COMMUNICATION

Plant-Plant Communications: Rhizosphere Signaling between Parasitic Angiosperms and Their Hosts. *Elizabeth M. Estabrook and John I. Yoder* 1

UPDATE ON EVOLUTION

Algal Phylogeny and the Origin of Land Plants. *Debashish Bhattacharya and Linda Medlin* 9

UPDATE ON PHOSPHORUS UPTAKE

Phosphorus Uptake by Plants. From Soil to Cell. *Daniel P. Schachtman, Robert J. Reid, and S.M. Ayling* 447

UPDATE ON BIOCHEMISTRY

The Activated Oxygen Role of Peroxisomes in Senescence. *Luis A. del Río, Gabriela M. Pastori, José M. Palma, Luisa M. Sandalio, Francisca Sevilla, Francisco J. Corpas, Ana Jiménez, Eduardo López-Huertas, and José A. Hernández* 1195

UPDATE ON PLANT-MICROBE INTERACTIONS

Regulation of Root and Fungal Morphogenesis in Mycorrhizal Symbioses. *Susan Jane Barker, Denis Tagu, and Gabriele Delp* 1201

RAPID COMMUNICATION

The Small, Methionine-Rich Chloroplast Heat-Shock Protein Protects Photosystem II Electron Transport during Heat Stress. *Scott A. Heckathorn, Craig A. Downs, Thomas D. Sharkey, and James S. Coleman* 439

BIOCHEMISTRY AND ENZYMOLOGY

Effects of Sulfanilamide and Methotrexate on ^{13}C Fluxes through the Glycine Decarboxylase/Serine Hydroxymethyltransferase Enzyme System in Arabidopsis. *Vikram Prabhu, K. Brock Chatson, Helen Lui, Garth D. Abrams, and John King* 137

Ethylene-Mediated Phospholipid Catabolic Pathway in Glucose-Starved Carrot Suspension Cells. *Soo Hyun Lee, Hyun Sook Chae, Taek Kyun Lee, Se Hee Kim, Sung Ho Shin, Bong Huey Cho, Sung Ho Cho, Bin G. Kang, and Woo Sung Lee* 223

Fatty Acid Elongation Is Independent of Acyl-Coenzyme A Synthetase Activities in Leek and *Brassica napus*. *Alenka Hlousek-Radojcic, Kimberly J. Evenson, Jan G. Jaworski, and Dusty Post-Beittenmiller* 251

Manipulation of Catalase Levels Produces Altered Photosynthesis in Transgenic Tobacco Plants. *Louise F. Brisson, Israel Zelitch, and Evelyn A. Havir* 259

Identification of Inositol 1,3,4-Trisphosphate 5-Kinase and Inositol 1,3,4,5-Tetrakisphosphate 6-Kinase in Immature Soybean Seeds. *Brian Q. Phillippy* 291

Metabolism of Polyamines in Transgenic Cells of Carrot Expressing a Mouse Ornithine Decarboxylase cDNA. *Scott E. Andersen, Dhundy R. Bastola, and Subhash C. Minocha* 299

Regulation of Leaf Senescence by Cytokinin, Sugars, and Light. Effects on NADH-Dependent Hydroxypyruvate Reductase. *Astrid Wingler, Antje von Schaewen, Richard C. Leegood, Peter J. Lea, and W. Paul Quick* 329

Identification and Partial Characterization of the Pectin Methyltransferase "Homogalacturonan-Methyltransferase" from Membranes of Tobacco Cell Suspensions. *Florence Goubet, Leona N. Council, and Debra Mohnen* 337

Uridine 5'-Diphosphate-Glucose Dehydrogenase from Soybean Nodules. *Douglas C. Stewart and Les Copeland* 349

Identification and Stereospecificity of the First Three Enzymes of 3-Dimethylsulfoniopropionate Biosynthesis in a Chlorophyte Alga. *Peter S. Summers, Kurt D. Nolte, Arthur J.L. Cooper, Heidi Borgeas, Thomas Leustek, David Rhodes, and Andrew D. Hanson* 369

Structural Analysis and Molecular Model of a Self-Incompatibility RNase from Wild Tomato. *Simon Parry, Ed Newbigin, David Craik, Kazuo T. Nakamura, Antony Bacic, and David Oxley* 463

Purification and Characterization of a Galactose-Rich Basic Glycoprotein in Tobacco. *Tetsuo Takeichi, Junko Takeuchi, Takako Kaneko, and Shinji Kawasaki* 477

Transport, Compartmentation, and Metabolism of Homoserine in Higher Plant Cells. Carbon-13- and Phosphorus-31-Nuclear Magnetic Resonance Studies. *Serge Aubert, Gilles Curien, Richard Bligny, Elisabeth Gout, and Roland Douce* 547

Floral Scent Production in *Clarkia breweri*. III. Enzymatic Synthesis and Emission of Benzenoid Esters. *Natalia Dudareva, Robert A. Raguso, Jihong Wang, Jeannine R. Ross, and Eran Pichersky* 599

Magnesium-Chelatase from Developing Pea Leaves. Characterization of a Soluble Extract from Chloroplasts and Resolution into Three Required Protein Fractions. *Ribo Guo, Meizhong Luo, and Jon D. Weinstein* 605

Chimeric *Arabidopsis thaliana* Ribulose-1,5-Bisphosphate Carboxylase/Oxygenase Containing a Pea Small Subunit Protein Is Compromised in Carbamylation. *Timothy P. Getzoff, Genhai Zhu, Hans J. Bohnert, and Richard G. Jensen* 695

4-Coumarate:Coenzyme A Ligase in Hybrid Poplar. Properties of Native Enzymes, cDNA Cloning, and Analysis of Recombinant Enzymes. *Sandra M. Allina, Aviva Pri-Hadash, David A. Theilmann, Brian E. Ellis, and Carl J. Douglas* 743

Oxygen Requirement and Inhibition of C_4 Photosynthesis. An Analysis of C_4 Plants Deficient in the C_3 and C_4 Cycles. *João P. Maroco, Maurice S.B. Ku, Peter J. Lea, Louisa V. Dever, Richard C. Leegood, Robert T. Furbank, and Gerald E. Edwards* 823

Influence of Precursor Availability on Alkaloid Accumulation by Transgenic Cell Line of *Catharanthus roseus*. *Serap Whitmer, Camilo Canel, Didier Hallard, Cecilia Gonçalves, and Robert Verpoorte* 853

An Embryo-Defective Mutant of Arabidopsis Disrupted in the Final Step of Biotin Synthesis. *David A. Patton, Amy L. Schetter, Linda H. Franzmann, Karin Nelson, Eric R. Ward, and David W. Meinke* 935

NADH-Monodehydroascorbate Oxidoreductase Is One of the Redox Enzymes in Spinach Leaf Plasma Membranes. *Alajos Bérczi and Ian M. Møller* 1029

Contribution of Malic Enzyme, Pyruvate Kinase, Phospho*enol*pyruvate Carboxylase, and the Krebs Cycle to Respiration and Biosynthesis and to Intracellular pH Regulation during Hypoxia in Maize Root Tips Observed by Nuclear Magnetic Resonance Imaging and Gas Chromatography-Mass Spectrometry. *Shaune Edwards, Bich-Ty Nguyen, Binh Do, and Justin K.M. Roberts* 1073

Biochemical Characterization of Stromal and Thylakoid-Bound Isoforms of Isoprene Synthase in Willow Leaves. *Mary C. Wildermuth and Ray Fall* 1111

Genetic Manipulation of Condensed Tannins in Higher Plants. II. Analysis of Birdsfoot Trefoil Plants Harboring Antisense Dihydroflavonol Reductase Constructs. *Mark P. Robbins, Adrian D. Bavage, Catherine Strudwicke, and Phillip Morris* 1133

N-Acylethanolamines. Formation and Molecular Composition of a New Class of Plant Lipids. *Kent D. Chapman, Swati Tripathy, Barney Venables, and Arland D. Desouza* 1163

Cyanogenesis in Cassava. The Role of Hydroxynitrile Lyase in Root Cyanide Production. *Wanda L.B. White, Diana I. Arias-Garzon, Jennifer M. McMahon, and Richard T. Sayre* 1219

Induced β-Carotene Synthesis Driven by Triacylglycerol Deposition in the Unicellular Alga *Dunaliella bardawil*. *Said Rabbani, Peter Beyer, Johannes v. Lintig, Philippe Hugueney, and Hans Kleinig* 1239

Effect of ATP Sulfurylase Overexpression in Bright Yellow 2 Tobacco Cells. Regulation of ATP Sulfurylase and SO_4^{2-} Transport Activities. *Yves Hatzfeld, Nicole Cathala, Claude Grignon, and Jean-Claude Davidian* 1307

Cyst(e)ine Is the Transport Metabolite of Assimilated Sulfur from Bundle-Sheath to Mesophyll Cells in Maize Leaves. *Marta Burgener, Marianne Suter, Stephanie Jones, and Christian Brunold* 1315

Participation of Mitochondrial Metabolism in Photorespiration. Reconstituted System of Peroxisomes and Mitochondria from Spinach Leaves. *Agepati S. Raghavendra, Sigrun Reumann, and Hans W. Heldt* 1333

Soybean Lipoxygenase-1 Oxidizes 3*Z*-Nonenal. A Route to 4*S*-Hydroperoxy-2*E*-Nonenal and Related Products. *Harold W. Gardner and Marilyn J. Grove* 1359

Extracellular Matrix Assembly in Diatoms (Bacillariophyceae). III. Organization of Fucoglucuronogalactans within the Adhesive Stalks of *Achnanthes longipes*. *Brandon A. Wustman, Jan Lind, Richard Wetherbee, and Michael R. Gretz* 1431

Partial Purification and Characterization of the Maize Mitochondrial Pyruvate Dehydrogenase Complex. *Jay J. Thelen, Jan A. Miernyk, and Douglas D. Randall* 1443

Polypeptides of the Maize Amyloplast Stroma. Stromal Localization of Starch-Biosynthetic Enzymes and Identification of an 81-Kilodalton Amyloplast Stromal Heat-Shock Cognate. *Ying Yu, Helen He Mu, Chen Mu-Forster, and Bruce P. Wasserman* 1451

Evidence for 1-(Malonylamino)cyclopropane-1-Carboxylic Acid Being the Major Conjugate of Aminocyclopropane-1-Carboxylic Acid in Tomato Fruit. *Galen Peiser and Shang Fa Yang* 1527

Surface Localization of Zein Storage Proteins in Starch Granules from Maize Endosperm. Proteolytic Removal by Thermolysin and in Vitro Cross-Linking of Granule-Associated Polypeptides *Chen Mu-Forster and Bruce P. Wasserman* 1563

WHOLE PLANT, ENVIRONMENTAL, AND STRESS PHYSIOLOGY

Aluminum Induces a Decrease in Cytosolic Calcium Concentration in BY-2 Tobacco Cell Cultures. *David L. Jones, Leon V. Kochian, and Simon Gilroy* 81

Defense Responses to Tetrapyrrole-Induced Oxidative Stress in Transgenic Plants with Reduced Uroporphyrinogen Decarboxylase or Coproporphyrinogen Oxidase Activity. *Hans-Peter Mock, Ulrich Keetman, Elisabeth Kruse, Barbara Rank, and Bernhard Grimm* 107

Co-Permeability of ^{3}H-Labeled Water and ^{14}C-Labeled Organic Acids across Isolated Plant Cuticles. Investigating Cuticular Paths of Diffusion and Predicting Cuticular Transpiration. *Sabine Niederl, Thomas Kirsch, Markus Riederer, and Lukas Schreiber* 117

Regulation of K^+ Channels in Maize Roots by Water Stress and Abscisic Acid. *Stephen K. Roberts* 145

The Distal Part of the Transition Zone Is the Most Aluminum-Sensitive Apical Root Zone of Maize. *Mayandi Sivaguru and Walter J. Horst* 155

Salinity Promotes Accumulation of 3-Dimethylsulfoniopropionate and Its Precursor *S*-Methylmethionine in Chloroplasts. *Claudine Trossat, Bala Rathinasabapathi, Elizabeth A. Weretilnyk, Tun-Li Shen, Zhi-Heng Huang, Douglas A. Gage, and Andrew D. Hanson* 165

Oxidative Damage in Pea Plants Exposed to Water Deficit or Paraquat. *Iñaki Iturbe-Ormaetxe, Pedro R. Escuredo, Cesar Arrese-Igor, and Manuel Becana* 173

Symplasmic Constriction and Ultrastructural Features of the Sieve Element/Companion Cell Complex in the Transport Phloem of Apoplasmically and Symplasmically Phloem-Loading Species. *Ronald Kempers, Ankie Ammerlaan, and Aart J.E. van Bel* 271

Molecular and Physiological Responses to Water Deficit in Drought-Tolerant and Drought-Sensitive Lines of Sunflower. Accumulation of Dehydrin Transcripts Correlates with Tolerance. *Françoise Cellier, Geneviève Conéjéro, Jean-Christophe Breitler, and Francine Casse* 319

Apoplastic Sugars, Fructans, Fructan Exohydrolase, and Invertase in Winter Oat. Responses to Second-Phase Cold Hardening. *David P. Livingston III and Cynthia A. Henson* 403

Aluminum Induces Oxidative Stress Genes in *Arabidopsis thaliana*. *Keith D. Richards, Eric J. Schott, Yogesh K. Sharma, Keith R. Davis, and Richard C. Gardner* 409

Heat-Shock-Induced Changes of Intracellular Ca^{2+} Level in Tobacco Seedlings in Relation to Thermotolerance. *Ming Gong, Arnold H. van der Luit, Marc R. Knight, and Anthony J. Trewavas* 429

Moderately High Temperatures Inhibit Ribulose-1,5-Bisphosphate Carboxylase/Oxygenase (Rubisco) Activase-Mediated Activation of Rubisco. *Urs Feller, Steven J. Crafts-Brandner, and Michael E. Salvucci* 539

Relationship between CO_2 Assimilation, Photosynthetic Electron Transport, and Active O_2 Metabolism in Leaves of Maize in the Field during Periods of Low Temperature. *Michael J. Fryer, James R. Andrews, Kevin Oxborough, David A. Blowers, and Neil R. Baker* 571

Effects of Hypoxia on $^{13}NH_4^+$ Fluxes in Rice Roots. Kinetics and Compartmental Analysis. *Herbert J. Kronzucker, Guy J.D. Kirk, M. Yavesh Siddiqi, and Anthony D.M. Glass* 581

Stress Induction of Mitochondrial Formate Dehydrogenase in Potato Leaves. *Cécile Hourton-Cabassa, Françoise Ambard-Bretteville, François Moreau, Jacques Davy de Virville, René Rémy, and Catherine Colas des Francs-Small* 627

Re-Aeration following Hypoxia or Anoxia Leads to Activation of the Antioxidative Defense System in Roots of Wheat Seedlings. *Sophia Biemelt, Ulrich Keetman, and Gerd Albrecht* 651

Effects of Short- and Long-Term Elevated CO_2 on the Expression of Ribulose-1,5-Bisphosphate Carboxylase/Oxygenase Genes and Carbohydrate Accumulation in Leaves of *Arabidopsis thaliana* (L.) Heynh. *Shu-Hua Cheng, Brandon d. Moore, and Jeffrey R. Seemann* 715

Formate Dehydrogenase, an Enzyme of Anaerobic Metabolism, Is Induced by Iron Deficiency in Barley Roots. *Kazuya Suzuki, Reiko Itai, Koichiro Suzuki, Hiromi Nakanishi, Naoko-Kishi Nishizawa, Etsuro Yoshimura, and Satoshi Mori* 725

Photosystem I Is an Early Target of Photoinhibition in Barley Illuminated at Chilling Temperatures. *Staffan Erling Tjus, Birger Lindberg Møller, and Henrik Vibe Scheller* 755

Osmotic Stress Induces Expression of Choline Monooxygenase in Sugar Beet and Amaranth. *Brenda L. Russell, Bala Rathinasabapathi, and Andrew D. Hanson* 859

Mapping Intercellular CO_2 Mole Fraction (C_i) in *Rosa rubiginosa* Leaves Fed with Abscisic Acid by Using Chlorophyll Fluorescence Imaging. Significance of C_i Estimated from Leaf Gas Exchange. *Sylvie Meyer and Bernard Genty* 947

Xyloglucan Octasaccharide XXLGol Derived from the Seeds of *Hymenaea courbaril* Acts as a Signaling Molecule. *Carem Vargas-Rechia, Fany Reicher, Maria Rita Sierakowski, Alain Heyraud, Hugues Driguez, and Yvette Liénart* 1013

The Role of Iron-Deficiency Stress Responses in Stimulating Heavy-Metal Transport in Plants. *Clara K. Cohen, Tama C. Fox, David F. Garvin, and Leon V. Kochian* 1063

Herbicide Safener-Binding Protein of Maize. Purification, Cloning, and Expression of an Encoding cDNA. *John S. Scott-Craig, John E. Casida, Lisa Poduje, and Jonathan D. Walton* 1083

Heat-Stress Response of Maize Mitochondria. *Adrian A. Lund, Paul H. Blum, Dinakar Bhattramakki, and Thomas E. Elthon* 1097

The Chloroplast Small Heat-Shock Protein Oligomer Is Not Phosphorylated and Does Not Dissociate during Heat Stress in Vivo. *Teri Chizue Suzuki, Denise C. Krawitz, and Elizabeth Vierling* 1151

Fourier Transform Infrared Microspectroscopy Detects Changes in Protein Secondary Structure Associated with Desiccation Tolerance in Developing Maize Embryos. *Willem F. Wolkers, Adriana Bochicchio, Giuseppe Selvaggi, and Folkert A. Hoekstra* 1169

Nonphotochemical Reduction of the Plastoquinone Pool in Sunflower Leaves Originates from Chlororespiration. *Taylor S. Feild, Ladislav Nedbal, and Donald R. Ort* 1209

Actin Depolymerization Affects Stress-Induced Translational Activity of Potato Tuber Tissue. *James K. Morelli, Wei Zhou, Jia Yu, Chen Lu, and Michael E. Vayda* 1227

Evidence for the Critical Role of Sucrose Synthase for Anoxic Tolerance of Maize Roots using a Double Mutant. *Bérénice Ricard, Tara VanToai, Prem Chourey, and Pierre Saglio* 1323

Parallel Changes in H_2O_2 and Catalase during Thermotolerance Induced by Salicylic Acid or Heat Acclimation in Mustard Seedlings. *James F. Dat, Humberto Lopez-Delgado, Christine H. Foyer, and Ian M. Scott* 1351

Characterization of a Gene for Spinach CAP160 and Expression of Two Spinach Cold-Acclimation Proteins in Tobacco. *Claudia Kaye, Lisa Neven, Andrea Hofig, Qin-Bao Li, Dale Haskell, and Charles Guy* 1367

Development, Characterization, and Application of a Cadmium-Selective Microelectrode for the Measurement of Cadmium Fluxes in Roots of *Thlaspi* Species and Wheat. *Miguel A. Piñeros, Jon E. Shaff, and Leon V. Kochian* 1393

Root Growth and Oxygen Relations at Low Water Potentials. Impact of Oxygen Availability in Polyethylene Glycol Solutions. *Paul E. Verslues, Eric S. Ober, and Robert E. Sharp* 1403

Characterization of Cadmium Binding, Uptake, and Translocation in Intact Seedlings of Bread and Durum Wheat Cultivars. *Jonathan J. Hart, Ross M. Welch, Wendell A. Norvell, Lori A. Sullivan, and Leon V. Kochian* 1413

Three Drought-Responsive Members of the Nonspecific Lipid Transfer Protein Gene Family in *Lycopersicon pennellii* Show Different Developmental Patterns of Expression. *Marcela B. Treviño and Mary A. O'Connell* 1461

Differential Regulation of Sugar-Sensitive Sucrose Synthases by Hypoxia and Anoxia Indicate Complementary Transcriptional and Posttranscriptional Responses. *Ying Zeng, Yong Wu, Wayne T. Avigne, and Karen E. Koch* 1573

A Cyanobacterium Lacking Iron Superoxide Dismutase Is Sensitized to Oxidative Stress Induced with Methyl Viologen but Is Not Sensitized to Oxidative Stress Induced with Norflurazon. *David J. Thomas, Thomas J. Avenson, Jannette B. Thomas, and Stephen K. Herbert* 1593

DEVELOPMENT AND GROWTH REGULATION

Phytochrome B and the Regulation of Circadian Ethylene Production in Sorghum. *Scott A. Finlayson, In-Jung Lee, and Page W. Morgan* 17

Altered Growth of Transgenic Tobacco Lacking Leaf Cytosolic Pyruvate Kinase. *Vicki L. Knowles, Sylvia G. McHugh, Zhiyuan Hu, David T. Dennis, Brian L. Miki, and William C. Plaxton* 45

Synthesis and Phosphorylation of Maize Acidic Ribosomal Proteins. Implications in Translational Regulation. *Raúl Aguilar, Leonel Montoya, and Estela Sánchez de Jiménez* 379

Auxin Transport Is Required for Hypocotyl Elongation in Light-Grown but Not Dark-Grown Arabidopsis. *Philip J. Jensen, Roger P. Hangarter, and Mark Estelle* 453

Light Promotion of Hypocotyl Gravitropism of a Starch-Deficient Tobacco Mutant Correlates with Plastid Enlargement and Sedimentation. *Stanislav Vitha, Ming Yang, John Z. Kiss, and Fred D. Sack* 495

Hormonal Control of Parthenocarpic Ovary Growth by the Apical Shoot in Pea. *María J. Rodrigo and José L. García-Martínez* 511

Temporal Regulation of Somatic Embryogenesis by Adjusting Cellular Polyamine Content in Eggplant. *Jitender Singh Yadav and Manchikatla Venkat Rajam* 617

Arabidopsis thaliana Responses to Mechanical Stimulation Do Not Require ETR1 or EIN2. *Keith A. Johnson, Melissa L. Sistrunk, Diana H. Polisensky, and Janet Braam* 643

Higher Activity of an Aldehyde Oxidase in the Auxin-Overproducing *superroot1* Mutant of *Arabidopsis thaliana*. *Mitsunori Seo, Shuichi Akaba, Takayuki Oritani, Marianne Delarue, Catherine Bellini, Michel Caboche, and Tomokazu Koshiba* 687

Phloem Transport of Fructans in the Crassulacean Acid Metabolism Species *Agave deserti*. *Ning Wang and Park S. Nobel* 709

Plastid Ontogeny during Petal Development in Arabidopsis. *Kevin A. Pyke and Anton M. Page* 797

Transdifferentiation of Mature Cortical Cells to Functional Abscission Cells in Bean. *Michael T. McManus, D. Stuart Thompson, Cledwyn Merriman, Linden Lyne, and Daphne J. Osborne* 891

Epicuticular Wax Accumulation and Fatty Acid Elongation Activities Are Induced during Leaf Development of Leeks. *Yoon Rhee, Alenka Hlousek-Radojcic, Jayakumar Ponsamuel, Dehua Liu, and Dusty Post-Beittenmiller* 901

Mortal: A Mutant of White Clover Defective in Nodal Root Development. *Derek W.R. White, Derek R. Woodfield, and John R. Caradus* 913

Controlled Cytokinin Production in Transgenic Tobacco Using a Copper-Inducible Promoter. *Marian Jane McKenzie, Vadim Mett, Paul Hugh Stewart Reynolds, and Paula Elizabeth Jameson* 969

Spatial and Temporal Analyses of Expansion and Cell Cycle in Sunflower Leaves. A Common Pattern of Development for All Zones of a Leaf and Different Leaves of a Plant. *Christine Granier and François Tardieu* 991

Photoperiod Control of Gibberellin Levels and Flowering in Sorghum. *In-Jung Lee, Kenneth R. Foster, and Page W. Morgan* 1003

Expression and Localization of Phospho*enol*pyruvate Carboxylase in Developing and Germinating Wheat Grains. *María-Cruz González, Lidia Osuna, Cristina Echevarría, Jean Vidal, and Francisco J. Cejudo* 1249

Dim-Red-Light-Induced Increase in Polar Auxin Transport in Cucumber Seedlings. I. Development of Altered Capacity, Velocity, and Response to Inhibitors. *James R. Shinkle, Rajan Kadakia, and Alan M. Jones* 1505

Analysis of Cell Division and Elongation Underlying the Developmental Acceleration of Root Growth in *Arabidopsis thaliana*. *Gerrit T.S. Beemster and Tobias I. Baskin* 1515

GENE REGULATION AND MOLECULAR GENETICS

PNZIP Is a Novel Mesophyll-Specific cDNA That Is Regulated by Phytochrome and a Circadian Rhythm and Encodes a Protein with a Leucine Zipper Motif. *Cheng Chao Zheng, Ron Porat, Pengzhe Lu, and Sharman D. O'Neill* 27

Tomato Phosphate Transporter Genes Are Differentially Regulated in Plant Tissues by Phosphorus. *Chunming Liu, Umesh S. Muchhal, Mukatira Uthappa, Andrzej K. Kononowicz, and Kashchandra G. Raghothama* 91

ADP-Glucose Pyrophosphorylase Is Localized to Both the Cytoplasm and Plastids in Developing Pericarp of Tomato Fruit. *Bing-Yuan Chen, Yi Wang, and Harry W. Janes* 101

Products of Proline Catabolism Can Induce Osmotically Regulated Genes in Rice. *Suresh Iyer and Allan Caplan* 203

Two Isoforms of NADPH:Cytochrome P450 Reductase in *Arabidopsis thaliana*. Gene Structure, Heterologous Expression in Insect Cells, and Differential Regulation. *Masaharu Mizutani and Daisaku Ohta* 357

Three 1-Aminocyclopropane-1-Carboxylate Synthase Genes Regulated by Primary and Secondary Pollination Signals in Orchid Flowers. *Anhthu Q. Bui and Sharman D. O'Neill* 419

Alteration of Hormone Levels in Transgenic Tobacco Plants Overexpressing the Rice Homeobox Gene *OSH1*. *Shinnosuke Kusaba, Yuriko Kano-Murakami, Makoto Matsuoka, Masanori Tamaoki, Tomoaki Sakamoto, Isomaro Yamaguchi, and Masashi Fukumoto* 471

Developmental and Hormonal Regulation of Genes Coding for Proline-Rich Proteins in Female Inflorescences and Kernels of Maize. *Matilde Josè-Estanyol and Pere Puigdomènech* 485

Characterization of DNA-Binding Proteins from Pea Mitochondria. *Frank Hatzack, Saskia Dombrowski, Axel Brennicke, and Stefan Binder* 519

Induction and Regulation of Expression of a Low-CO_2-Induced Mitochondrial Carbonic Anhydrase in *Chlamydomonas reinhardtii*. *Mats Eriksson, Per Villand, Per Gardeström, and Göran Samuelsson* 637

Expression of a Soybean Hydroxyproline-Rich Glycoprotein Gene Is Correlated with Maturation of Roots. *Ji Hoon Ahn, Yeonhee Choi, Sang-Gu Kim, Young Myung Kwon, Yang Do Choi, and Jong Seob Lee* 671

Cloning of a Tobacco Apoplasmic Invertase Inhibitor. Proof of Function of the Recombinant Protein and Expression Analysis during Plant Development. *Steffen Greiner, Silke Krausgrill, and Thomas Rausch* 733

Uridine 5′-Monophosphate Synthase Is Transcriptionally Regulated by Pyrimidine Levels in *Nicotiana plumbaginifolia*. *Djoko Santoso and Robert Thornburg* 815

Specific Soybean Lipoxygenases Localize to Discrete Subcellular Compartments and Their mRNAs Are Differentially Regulated by Source-Sink Status. *Lowry C. Stephenson, Thomas W. Bunker, Wesley E. Dubbs, and Howard D. Grimes* 923

Two Pine Endo-β-1,4-Glucanases Are Associated with Rapidly Growing Reproductive Structures. *Carol A. Loopstra, Aidyn Mouradov, Adam Vivian-Smith, Tina V. Glassick, Beth V. Gale, Simon G. Southerton, Heidi Marshall, and Robert D. Teasdale* 959

Expression of an Arabidopsis Aspartate Kinase/Homoserine Dehydrogenase Gene Is Metabolically Regulated by Photosynthesis-Related Signals but Not by Nitrogenous Compounds. *Judith X. Zhu-Shimoni and Gad Galili* 1023

Differential Expression of a Novel Gene in Response to Coronatine, Methyl Jasmonate, and Wounding in the *Coi1* Mutant of Arabidopsis. *Celso E. Benedetti, Cinthia L. Costa, Silvia R. Turcinelli, and Paulo Arruda* 1037

Differential Expression of the Arabidopsis *Nia1* and *Nia2* Genes. Cytokinin-Induced Nitrate Reductase Activity Is Correlated with Increased *Nia1* Transcription and mRNA Levels. *Xiaodan Yu, Sujatha Sukumaran, and László Márton* 1091

Regulation of Tomato Fruit Polygalacturonase mRNA Accumulation by Ethylene. A Re-Examination. *Yaron Sitrit and Alan B. Bennett* 1145

The *GA2* Locus of *Arabidopsis thaliana* Encodes *ent*-Kaurene Synthase of Gibberellin Biosynthesis. *Shinjiro Yamaguchi, Tai-ping Sun, Hiroshi Kawaide, and Yuji Kamiya* 1271

The Phytochrome Response of the *Lemna gibba NPR1* Gene Is Mediated Primarily through Changes in Abscisic Acid Levels. *Sharlene C. Weatherwax, Shirley A. Williams, Sonia Tingay, and Elaine M. Tobin* 1299

Nuclear-Gene Mutations Suppress a Defect in the Expression of the Chloroplast-Encoded Large Subunit of Ribulose-1,5-Bisphosphate Carboxylase/Oxygenase. *Seokjoo Hong and Robert J. Spreitzer* 1387

Structure and Expression of a Dhurrinase (β-Glucosidase) from Sorghum. *Muzaffer Cicek and Asim Esen* 1469

Accumulation of a Clock-Regulated Transcript during Flower-Inductive Darkness in *Pharbitis nil*. *Kimiyo Sage-Ono, Michiyuki Ono, Hiroshi Harada, and Hiroshi Kamada* 1479

Regulation of Oleoresinosis in Grand Fir (*Abies grandis*). Differential Transcriptional Control of Monoterpene, Sesquiterpene, and Diterpene Synthase Genes in Response to Wounding. *Christopher L. Steele, Sadanobu Katoh, Jörg Bohlmann, and Rodney Croteau* 1497

Genes Involved in Osmoregulation during Turgor-Driven Cell Expansion of Developing Cotton Fibers Are Differentially Regulated. *Lawrence B. Smart, Fakrieh Vojdani, Masayoshi Maeshima, and Thea A. Wilkins* 1539

CELL BIOLOGY AND SIGNAL TRANSDUCTION

Fast Induction of High-Affinity HCO_3^- Transport in Cyanobacteria. *Dieter Sültemeyer, Barbara Klughammer, Murray R. Badger, and G. Dean Price* 183

Uptake of HCO_3^- and CO_2 in Cells and Chloroplasts from the Microalgae *Chlamydomonas reinhardtii* and *Dunaliella tertiolecta*. *Gabi Amoroso, Dieter Sültemeyer, Christoph Thyssen, and Heinrich P. Fock* 193

Mapping the Functional Roles of Cap Cells in the Response of Arabidopsis Primary Roots to Gravity. *Elison B. Blancaflor, Jeremiah M. Fasano, and Simon Gilroy* 213

Molecular and Enzymatic Characterization of Three Phosphoinositide-Specific Phospholipase C Isoforms from Potato. *Joachim Kopka, Christophe Pical, Julie E. Gray, and Bernd Müller-Röber* 239

Regulation of Actin Tension in Plant Cells by Kinases and Phosphatases. *Sharon Grabski, Eric Arnoys, Benjamin Busch, and Melvin Schindler* 279

Anion Channels and the Stimulation of Anthocyanin Accumulation by Blue Light in Arabidopsis Seedlings. *Bosl Noh and Edgar P. Spalding* 503

Fusicoccin Binding to Its Plasma Membrane Receptor and the Activation of the Plasma Membrane H^+-ATPase. IV. Fusicoccin Induces the Association between the Plasma Membrane H^+-ATPase and the Fusicoccin Receptor. *Claudio Olivari, Cristina Meanti, Maria Ida De Michelis, and Franca Rasi-Caldogno* 529

Evidence for a Cytoskeleton-Associated Binding Site Involved in Prolamine mRNA Localization to the Protein Bodies in Rice Endosperm Tissue. *Douglas G. Muench, Yujia Wu, Sean J. Coughlan, and Thomas W. Okita* 559

Oxidative Burst and Hypoosmotic Stress in Tobacco Cell Suspensions. *Anne-Claire Cazalé, Marie-Aude Rouet-Mayer, Hélène Barbier-Brygoo, Yves Mathieu, and Christiane Laurière* 659

Fusicoccin Counteracts the *n*-Ethylmaleimide and Silver-Induced Stimulation of Oxygen Uptake in *Egeria densa* Leaves. *Maria Teresa Marrè and Francesco Albergoni* 681

Identification of a Novel Isoform of the Chloroplast-Coupling Factor α-Subunit. *Kent O. Burkey and James N. Mathis* 703

Calcium-Dependent Protein Phosphorylation May Mediate the Gibberellic Acid Response in Barley Aleurone. *Sian Ritchie and Simon Gilroy* 765

Guard Cells Possess a Calcium-Dependent Protein Kinase That Phosphorylates the KAT1 Potassium Channel. *Jiaxu Li, Yuh-Ru Julie Lee, and Sarah M. Assmann* 785

Identification of a Role for an Azide-Sensitive Factor in the Thylakoid Transport of the 17-Kilodalton Subunit of the Photosynthetic Oxygen-Evolving Complex. *Ellen A. Leheny, Sarah A. Teter, and Steven M. Theg* 805

Short-Lived and Phosphorylated Proteins Contribute to Carrier-Mediated Efflux, but Not to Influx, of Auxin in Suspension-Cultured Tobacco Cells. *Alain Delbarre, Philippe Muller, and Jean Guern* 833

Purification of the Plasma Membrane Ca^{2+}-ATPase from Radish Seedlings by Calmodulin-Agarose Affinity Chromatography. *Cristina Bonza, Antonella Carnelli, Maria Ida De Michelis, and Franca Rasi-Caldogno* 845

Characterization of SKT1, an Inwardly Rectifying Potassium Channel from Potato, by Heterologous Expression in Insect Cells. *Sabine Zimmermann, Ina Talke, Thomas Ehrhardt, Gabriele Nast, and Bernd Müller-Röber* 879

Extending the Microtubule/Microfibril Paradigm. Cellulose Synthesis Is Required for Normal Cortical Microtubule Alignment in Elongating Cells. *Deborah D. Fisher and Richard J. Cyr* 1043

Transit Peptide Mutations That Impair in Vitro and in Vivo Chloroplast Protein Import Do Not Affect Accumulation of the γ-Subunit of Chloroplast ATPase. *Karen L. Kindle and Susan D. Lawrence* 1179

Biological Activity of Reducing-End-Derivatized Oligogalacturonides in Tobacco Tissue Cultures. *Mark D. Spiro, Brent L. Ridley, Stefan Eberhard, Keith A. Kates, Yves Mathieu, Malcolm A. O'Neill, Debra Mohnen, Jean Guern, Alan Darvill, and Peter Albersheim* 1289

Cloning and Characterization of *AtRGP1*. A Reversibly Autoglycosylated Arabidopsis Protein Implicated in Cell Wall Biosynthesis. *Ivan J. Delgado, Zhaohong Wang, Amy de Rocher, Kenneth Keegstra, and Natasha V. Raikhel* 1339

Actin-Bundling Protein Isolated from Pollen Tubes of Lily. Biochemical and Immunocytochemical Characterization. *Etsuo Yokota, Kei-ichiro Takahara, and Teruo Shimmen* 1421

Different Phototransduction Kinetics of Phytochrome A and Phytochrome B in *Arabidopsis thaliana*. *Jorge J. Casal, Pablo D. Cerdán, Roberto J. Staneloni, and Laura Cattaneo* 1533

The Intracellular Localization of Ribulose-1,5-Bisphosphate Carboxylase/Oxygenase in *Chlamydomonas reinhardtii*. *Olga N. Borkhsenious, Catherine B. Mason, and James V. Moroney* 1585

BIOENERGETICS

Nucleotide Triphosphates Are Required for the Transport of Glycolate Oxidase into Peroxisomes. *Donna G. Brickner and Laura J. Olsen* 309

Molecular Cloning of Vacuolar H^+-Pyrophosphatase and Its Developmental Expression in Growing Hypocotyl of Mung Bean. *Yoichi Nakanishi and Masayoshi Maeshima* 587

Heterogeneity and Photoinhibition of Photosystem II Studied with Thermoluminescence. *Simone Andrée, Engelbert Weis, and Anja Krieger* 1053

Energy Sources for HCO_3^- and CO_2 Transport in Air-Grown Cells of *Synechococcus* UTEX 625. *Qinglin Li and David T. Canvin* 1125

Reversibility of H^+-ATPase and H^+-Pyrophosphatase in Tonoplast Vesicles from Maize Coleoptiles and Seeds. *Arnoldo Rocha Façanha and Leopoldo de Meis* 1487

Photosystem II Cyclic Heterogeneity and Photoactivation in the Diazotrophic, Unicellular Cyanobacterium *Cyanothece* Species ATCC 51142. *Pascal C. Meunier, Milagros S. Colón-López, and Louis A. Sherman* 1551

PLANT-MICROBE AND PLANT-INSECT INTERACTIONS

Antioxidant Defenses in the Peripheral Cell Layers of Legume Root Nodules. *David A. Dalton, Shannon L. Joyner, Manuel Becana, Iñaki Iturbe-Ormaetxe, and J. Mark Chatfield* 37

Studying Early Nodulin Gene *ENOD40* Expression and Induction by Nodulation Factor and Cytokinin in Transgenic Alfalfa. *Yiwen Fang and Ann M. Hirsch* 53

The Three-Dimensional Structure of *Aspergillus niger* Pectin Lyase B at Å Resolution. *Jacqueline Vitali, Brian Schick, Harry C.M. Kester, Jaap Visser, and Frances Jurnak* 69

Tobamovirus and Potyvirus Accumulation in Minor Veins of Inoculated Leaves from Representatives of the Solanaceae and Fabaceae. *Xin Shun Ding, Shelly A. Carter, C. Michael Deom, and Richard S. Nelson* 125

Accumulation of Salicylic Acid and 4-Hydroxybenzoic Acid in Phloem Fluids of Cucumber during Systemic Acquired Resistance Is Preceded by a Transient Increase in Phenylalanine Ammonia-Lyase Activity in Petioles and Stems. *Jennifer Smith-Becker, Eric Marois, Elisabeth J. Huguet, Sharon L. Midland, James J. Sims, and Noel T. Keen* 231

Endogenous Methyl Salicylate in Pathogen-Inoculated Tobacco Plants. *Mirjana Seskar, Vladimir Shulaev, and Ilya Raskin* 387

Chickpea Defensive Proteinase Inhibitors Can Be Inactivated by Podborer Gut Proteinases. *Ashok P. Giri, Abhay M. Harsulkar, Vasanti V. Deshpande, Mohini N. Sainani, Vidya S. Gupta, and Prabhakar K. Ranjekar* 393

Respiratory Elicitors from *Rhizobium meliloti* Affect Intact Alfalfa Roots. *Hanne Volpin and Donald A. Phillips* 777

Rearrangement of Actin Microfilaments in Plant Root Hairs Responding to *Rhizobium etli* Nodulation Signals. *Luis Cárdenas, Luis Vidali, Jimena Domínguez, Héctor Pérez, Federico Sánchez, Peter K. Hepler, and Carmen Quinto* 871

Reduction of Light-Induced Anthocyanin Accumulation in Inoculated Sorghum Mesocotyls. Implications for a Compensatory Role in the Defense Response. *Sze-Chung Clive Lo and Ralph L. Nicholson* 979

Evidence that the Plant Host Synthesizes the Heme Moiety of Leghemoglobin in Root Nodules. *Maria A. Santana, Kaarina Pihakaski-Maunsbach, Niels Sandal, Kjeld A. Marcker, and Alison G. Smith* 1259

Intracellular pH in Arbuscular Mycorrhizal Fungi. A Symbiotic Physiological Marker. *Mario Jolicoeur, Sophie Germette, Martin Gaudette, Michel Perrier, and Guillaume Bécard* 1279

Comparative Biochemistry of the Oxidative Burst Produced by Rose and French Bean Cells Reveals Two Distinct Mechanisms. *G. Paul Bolwell, Dewi R. Davies, Chris Gerrish, Chung-Kyoon Auh, and Terence M. Murphy* 1379

THE ELECTRONIC PLANT GENE REGISTER 445, 867, 1191, 1603

CORRECTIONS

Manipulation of Catalase Levels Produces Altered Photosynthesis in Transgenic Tobacco Plants (Vol. 116: 259–269, 1998). *Louise F. Brisson, Israel Zelitch, and Evelyn A. Havir* 870

Higher Activity of an Aldehyde Oxidase in the Auxin-Overproducing *superroot1* Mutant of *Arabidopsis thaliana* (Vol. 116: 687–693, 1998). *Mitsunori Seo, Shuichi Akaba, Takayuki Oritani, Marianne Delarue, Catherine Bellini, Michel Caboche, and Tomokazu Koshiba* 1607